e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2021; 11(6); 228-236

Original Research Article

Surgical Site Infections in Emergency Laparotomy: Incidence and Risk Factors in West Bengal Region

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Received: 11-08-2021 / Revised: 18-09-2021 / Accepted: 21-10-2021

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Conflict of interest: Nil

Abstract

Background: Surgical site infections (SSIs) are among the most common postoperative complications following emergency abdominal surgeries and are associated with increased morbidity, prolonged hospital stay, and higher healthcare costs. Emergency laparotomy patients are particularly vulnerable to SSIs because of contaminated surgical fields, delayed presentation, and associated comorbidities. Limited prospective data are available regarding the incidence, microbial profile, and associated risk factors of SSIs in West Bengal, India.

Aim: To determine the incidence of surgical site infections following emergency laparotomy, identify the predominant microbial pathogens, and evaluate the associated demographic, clinical, and operative risk factors.

Methodology: This prospective observational study was conducted in the Department of General Surgery at ICARE Institute of Medical Sciences and Research, West Bengal, over one year. A total of 237 patients undergoing emergency laparotomy were included. Patients were followed postoperatively for the development of SSI. Clinical details, operative factors, microbiological culture reports, and antibiotic sensitivity patterns were recorded and analyzed using appropriate statistical methods.

Results: The overall incidence of SSI was 17.3%, with superficial SSI being the most common type. Advanced age, tobacco consumption, anemia, elevated BMI, hypoproteinemia, prolonged operative duration, increased blood loss, and drain placement showed significant association with SSI development. Perforation peritonitis accounted for the highest number of infections. Escherichia coli was the predominant organism isolated, followed by Klebsiella spp. and Pseudomonas spp. Piperacillin-tazobactam and meropenem demonstrated the highest antimicrobial sensitivity.

Conclusion: Surgical site infections remain a significant complication following emergency laparotomy. Identification of high-risk patients, optimization of nutritional and clinical status, strict aseptic precautions, and culture-guided antibiotic therapy are essential to reduce postoperative morbidity and improve surgical outcomes.

Keywords: Surgical Site Infection, Emergency Laparotomy, Escherichia Coli, Risk Factors, Microbial Profile, Antibiotic Sensitivity, West Bengal.

Introduction

Surgical site infections (SSIs) are one of the most common and significant surgical complications globally and are a significant proportion of healthcare-associated infections (HAIs) in surgical patients [1,2]. They are linked with higher rates of postoperative complications, longer hospital stays, impaired wound healing, re-operation rates, and significant economic costs for health care systems. Although there has been great progress in aseptic technique, sterilization, antibiotic prophylaxis, and perioperative care, SSIs remain an important problem in developed and developing countries.

The Centers for Disease Control and Prevention (CDC) classify SSI as infection at the site of surgery, deep soft tissues, or organ spaces affected by surgery, within 30 days of surgery, or within 1 year following the placement of prosthetic material [3]. Based on anatomic involvement, these infections are divided into superficial incisional SSI, deep incisional SSI, and organ/space SSI. SSIs have an adverse effect on patient comfort and psychological stress and also are associated with increased mortality rates particularly in critical surgical patients and emergency patients [4].

Emergency laparotomy is the most frequently performed life-saving abdominal surgical procedure in tertiary care hospitals. It is indicated for perforation peritonitis, intestinal obstruction, abdominal trauma, ischemic bowel disease and intra-abdominal sepsis. Emergency surgery is typically performed under a rush of circumstances and not enough time to optimise the patient preoperatively as in an elective surgery. Patients undergoing emergency laparotomy are particularly at risk of postoperative SSIs due to factors like hemodynamic instability, contamination of the peritoneal cavity, poor nutritional status, anemia, diabetes mellitus, delayed presentation and pre-existing infections [5].

Developing countries such as India are especially affected by SSIs, due to the various problems associated with healthcare, such as overcrowding, insufficient resources, inadequate sanitation, delayed healthcare access, and the rising incidence of antimicrobial resistance. Emergency abdomen surgeries are a significant proportion of general surgical admissions in government and tertiary hospitals in eastern India, notably West Bengal. Patients often are found late in the disease process, with generalized peritonitis, septicemia and heavy contamination of the abdominal cavity, making the risk of postoperative wound infections and complications high. Prospective data on the incidence, microbiological spectrum and risk factors of SSIs following emergency laparotomy are scarce at the regional level, however.

There are numerous factors related to the patient, surgery and the hospital that have been used to identify in multiple studies as playing a role in the development of SSIs. Advanced age, malnutrition, obesity, diabetes mellitus, anemia, smoking, immunosuppression and longer hospital stay before surgery are patient-related risk factors. Other factors related to surgery like long operations, surgical urgency, wound contamination, blood loss, poor surgical sterile precautions and lack of appropriate antibiotic coverage are also important [6]. This risk is even higher during laparotomy in the event of an emergency as the intraabdominal contents are exposed and the blood supply is compromised by sepsis and shock.

The etiology of SSIs is the presence of microorganisms in the surgical site due to endogenic or exogenic contamination. Endogenous organisms come from the patient's own skin flora or from the patient's gastrointestinal tract; exogenous pathogens can be introduced by surgical instruments, the operating room environment, or by healthcare personnel [7]. The most frequent microorganisms isolated from postoperative wound infections are Staphylococcus aureus, Escherichia coli, Klebsiella species, Pseudomonas aeruginosa, Enterococcus species and anaerobic bacteria such as Bacteroides species [8]. The growing occurrence of multidrug-resistant organisms such as methicillin-resistant Staphylococcus aureus (MRSA) and extended-spectrum beta-lactamase (ESBL)-producing gram-negative bacteria have added to the challenge of SSI management and reliance on higher generation antibiotics.

Patients and the healthcare system incur a heavy clinical and economic burden from SSIs. Research has shown that patients who suffer from SSI will need extended antibiotic treatment, multiple dressing changes, intensive wound care, secondary suturing, and occasionally re-exploration surgery [9]. This increases the length of the hospital stay, cost of treatment, loss of productivity, and quality of life. If left untreated, SSIs can progress to septicemia, multiorgan dysfunction syndrome and death. Therefore, prevention and early detection of risk factors are still of paramount importance for surgical treatment.

A number of preventive strategies have been suggested to help lower the rate of SSIs. They include the strict use of aseptic technique, correct skin preparation, minimizing patient comorbidities, maintaining intraoperative normothermia, ensuring glycaemic control, and judicious use of prophylactic antibiotics [10]. Prophylactic antibiotics given within two hours prior to the surgical incision may decrease postoperative wound infections. At the institutional level, continuous monitoring and periodic microbiological analysis is required to inform antibiotic policies and infection control practices.

Considering the high incidence of SSI among patients of emergency abdominal surgeries and the lack of prospective regional data in West Bengal, the study was conducted to assess the prevalence of SSI after emergency laparotomy, to identify the major microbial pathogens and, to study the associated risk factors associated with the development of SSI. The knowledge of the microbial profile and determinants of SSIs in this setting will help in developing evidence-based preventive measures, optimization of perioperative management protocol, reduce outcome morbidity and overall surgical outcomes in tertiary healthcare center of West Bengal, India.

The study was thus designed to have the following aims: (1) to determine the incidence of surgical site infection after emergency laparotomy; (2) to correlate microbiological organisms to the different categories of surgical site infection (superficial, deep and organ/space infection); and (3) to analyze the association between the various patient-related and operative risk factors with the occurrence of postoperative SSIs.

Materials and Methods

Study Design: This hospital-based study was conducted using a prospective observational design to evaluate the incidence of surgical site infections (SSIs) following emergency laparotomy. The study also aimed to identify the microbial profile associated with postoperative wound infections and analyze the various demographic, clinical, and perioperative risk factors contributing to the development of SSIs among patients undergoing emergency abdominal surgery.

Study Area: The study was carried out in the Department of General Surgery, ICARE Institute of Medical Sciences and Research and Dr. Bidhan Chandra Roy Hospital, Haldia, West Bengal, India.

Study Duration: The study was conducted over a period of one year.

Sample Size: A total of 237 patients undergoing emergency laparotomy were included in the study. The sample size was selected considering the expected prevalence of postoperative surgical site infections reported in previous studies along with the feasibility of recruitment within the study duration. Including an adequate number of participants helped improve the reliability and statistical validity of the study findings.

Study Population: The study population consisted of patients admitted to the Department of General Surgery who underwent emergency laparotomy for various abdominal surgical emergencies during the study period. Patients were monitored from the preoperative period until postoperative recovery to assess the occurrence of surgical site infections and related complications.

Data Collection: Data collection was carried out using a structured and predesigned case record form. Detailed demographic and clinical information of the patients was documented, including age, sex, body mass index (BMI), presenting complaints, comorbid conditions such as diabetes mellitus and hypertension, anemia status, smoking and alcohol history, operative diagnosis, duration of surgery, intraoperative blood loss, and duration of hospital stay. Postoperative wound assessment was performed regularly to identify clinical features suggestive of surgical site infection, including redness, swelling, pain, purulent discharge, fever, delayed wound healing, or wound dehiscence.

Inclusion Criteria

- Patients aged more than 12 years.
- Patients undergoing emergency laparotomy in the Department of General Surgery.
- Patients willing to provide written informed consent for participation in the study.

Exclusion Criteria

- Patients with a history of previous abdominal surgery.
- Patients with pre-existing infection at the operative site.
- Patients aged 12 years or younger.
- Pregnant women.
- Immunocompromised patients.
- Patients unwilling to participate or not providing consent.

Study Procedure: All eligible patients undergoing emergency laparotomy were evaluated clinically and followed prospectively during the postoperative period. Standard perioperative protocols, including antibiotic prophylaxis and aseptic surgical techniques, were followed uniformly. Patients were regularly examined postoperatively for evidence of surgical site infection. In patients suspected to have SSI, wound swab samples were collected under sterile precautions. One swab was obtained after paint draping during surgery, while additional swabs were collected from postoperative infected wounds. Repeat samples were collected whenever there was progression or persistence of infection. The collected samples were transported promptly to the microbiology laboratory for further processing and analysis.

Microbiological Analysis: The collected wound specimens were processed in the microbiology laboratory using standard microbiological methods. Samples were inoculated onto sheep blood agar, MacConkey agar, and Robertson's cooked meat medium for the isolation of aerobic and anaerobic organisms. The inoculated media were incubated under appropriate aerobic and anaerobic conditions for 24–48 hours. Tryptic soy broth was used as an enrichment medium and subcultures were performed after 24 hours. Fungal culture was carried out using Sabouraud's dextrose agar and observed for up to 10 days before reporting negative growth. Identification of isolated organisms was performed using standard phenotypic and biochemical methods. Antibiotic susceptibility testing was conducted by the Kirby–Bauer disk diffusion method, and interpretation of sensitivity patterns was carried out according to Clinical Laboratory Standards Institute (CLSI) guidelines.

Statistical Analysis: The collected data were compiled and entered into Microsoft Excel and subsequently analyzed using appropriate statistical software. Descriptive statistical methods such as mean, standard deviation, median, mode, frequency, and percentage were used to summarize the data. The chi-square test was applied to evaluate the association between various risk factors and the occurrence of surgical site infections. Variables including diabetes mellitus, hypertension, anemia, BMI, smoking, alcohol consumption, duration of surgery, and intraoperative blood loss were analyzed for statistical significance. A p-value of less than 0.05 was considered statistically significant."

Result

Table 1 presents the incidence and distribution of surgical site infections (SSI) among the 237 patients included in the study. The majority of patients did not develop SSI, accounting for 82.7% (n=196) of cases. Overall, surgical site infections were observed in 17.3% (n=41) of patients following emergency laparotomy. Among the different types of SSI, superficial SSI was the most common, occurring in 11.4% (n=27) of cases, followed by deep incisional SSI in 4.6% (n=11) and organ/space SSI in 1.3% (n=3) of patients. These findings indicate that superficial wound infections constituted the predominant form of postoperative SSI in the study population.

Table 1: Incidence and Types of Surgical Site Infections (N = 237)

Type of SSI	Number	Percentage
No SSI	196	82.70%
Superficial SSI	27	11.40%
Deep Incisional SSI	11	4.60%
Organ/Space SSI	3	1.30%
Total SSI	41	17.30%

Table 2 presents the demographic characteristics of the study participants and their association with surgical site infections (SSI). Among the 237 patients, the highest number belonged to the age group below 40 years (n=99), of whom 13 developed SSI, while 16 cases of SSI were observed in the 40–60 years age group and 12 cases in patients older than 60 years. The association between age and SSI was statistically significant (p=0.041), indicating that advancing age was associated with a higher risk of postoperative infection. Regarding sex distribution, males constituted the majority of patients (n=169), with 31 cases of SSI, whereas females accounted for 68 patients with 10 SSI cases. However, the association between sex and SSI was not statistically significant (p=0.562). These findings suggest that age was an important demographic factor influencing the occurrence of surgical site infections, while gender did not significantly affect SSI risk in this study population.

Table 2: Demographic Characteristics and Association with Surgical Site Infections

Variable	No SSI (n=196)	SSI Present (n=41)	Total (N=237)	P-value
Age Group				
<40 years	86	13	99	0.041
40–60 years	74	16	90	
>60 years	36	12	48	
Sex				
Male	138	31	169	0.562
Female	58	10	68	

Table 3 presents the association between various clinical risk factors and the occurrence of surgical site infections (SSI) among the 237 study participants. Tobacco consumption showed a statistically significant association with SSI (χ^2=8.71, p=0.003), with 24 out of 95 tobacco users developing postoperative infections. Similarly, anemia with hemoglobin levels below 10 g/dL was significantly associated with SSI (χ^2=6.12, p=0.013), as 25 out of 104 anemic patients developed infections. Increased body mass index (BMI >25 kg/m²) also demonstrated a significant relationship with SSI (χ^2=7.34, p=0.007), with 22 infections observed among 90 overweight patients. Hypoproteinemia had the strongest association with SSI (χ^2=9.28, p=0.002), with 21 out of 79 affected patients developing infections. In contrast, hypertension, diabetes mellitus, and alcohol consumption did not show statistically significant associations with SSI, as their p-values were greater than 0.05. These findings indicate that nutritional status, obesity, anemia, and tobacco use are important clinical risk factors contributing to surgical site infections following emergency laparotomy.

Table 3: Association Between Clinical Risk Factors and Surgical Site Infections

Risk Factor	No SSI (n=196)	SSI Present (n=41)	Total	Chi-square Value	P-value
Hypertension	49	12	61	0.84	0.359
Diabetes Mellitus	46	11	57	0.63	0.426
Tobacco Consumption	71	24	95	8.71	0.003
Alcohol Consumption	67	15	82	0.12	0.729
Anemia (Hb <10 g/dL)	79	25	104	6.12	0.013
BMI >25 kg/m²	68	22	90	7.34	0.007
Hypoproteinemia	58	21	79	9.28	0.002

Table 4 illustrates the association between operative factors and the occurrence of surgical site infections (SSI) among the 237 patients studied. A higher proportion of SSI was observed in patients with a longer interval between onset of symptoms and surgery, particularly in those operated after more than 48 hours, where 15 out of 65 patients developed SSI, although this association was not statistically significant (p=0.087). Operative duration showed a significant association with SSI (p=0.031), as infections were more common in surgeries lasting more than 2 hours (27 cases) compared to procedures completed within 1 hour (2 cases). Total blood loss was also significantly associated with SSI occurrence (p=0.048), with higher infection rates seen in patients losing more than 500 mL of blood during surgery. Drain placement demonstrated a statistically significant relationship with SSI (p=0.006), as patients with intra-abdominal drains had the highest number of infections (30 cases), whereas patients without drains had the lowest incidence of SSI (4 cases). These findings suggest that prolonged operative time, increased blood loss, and drain placement are important operative risk factors contributing to surgical site infections following emergency laparotomy.

Table 4: Association Between Operative Factors and Surgical Site Infections

Operative Factors	No SSI (n=196)	SSI Present (n=41)	Total	P-value
Symptoms of Surgery Interval				
<24 hours	51	8	59	0.087
24–48 hours	95	18	113	
>48 hours	50	15	65	
Operative Time				
<1 hour	19	2	21	0.031
1–2 hours	87	12	99	
>2 hours	90	27	117	
Total Blood Loss				
<150 mL	93	14	107	0.048
150–500 mL	76	16	92	
>500 mL	27	11	38	
Drain Placement				
No Drain	41	4	45	0.006
Subcutaneous Drain	63	7	70	
Intra-abdominal Drain	92	30	122	

Table 5 shows the association between the underlying surgical diagnosis and the occurrence of surgical site infections (SSI) among the 237 patients included in the study. Perforation peritonitis was the most common diagnosis, accounting for 104 cases overall, of which 18 patients developed SSI, representing the highest number of infections among all diagnostic categories. Acute appendicitis was the second most common condition with 78 cases, including 10 cases of SSI. Acute cholecystitis and liver abscess were associated with SSI in 4 cases each, while intestinal obstruction, sigmoid volvulus, splenic injury, and other conditions contributed smaller numbers of infections. Overall, 41 patients developed SSI whereas 196 patients did not develop postoperative infection. These findings suggest that patients undergoing emergency laparotomy for contaminated intra-abdominal conditions such as perforation peritonitis were more likely to develop surgical site infections compared to other diagnoses.

Table 5: Association Between Diagnosis and Surgical Site Infections

Diagnosis	No SSI (n=196)	SSI Present (n=41)	Total
Acute Appendicitis	68	10	78
Acute Cholecystitis	14	4	18
Perforation Peritonitis	86	18	104
Liver Abscess	10	4	14
Intestinal Obstruction	8	2	10
Sigmoid Volvulus	4	1	5
Splenic Injury	3	1	4
Others	3	1	4
Total	196	41	237

Table 6 presents the microbial profile of the 41 surgical site infection (SSI) cases identified in the study. Escherichia coli was the most commonly isolated organism, accounting for 34.1% (n=14) of cases, followed by Klebsiella spp. in 14.6% (n=6). Pseudomonas spp. and Proteus spp. were isolated in 9.8% (n=4) and 7.3% (n=3) of cases, respectively. Other organisms identified included Acinetobacter spp., Enterococcus spp., and Staphylococcus aureus, each contributing 4.9% (n=2) of infections. MRSA and Streptococcus spp. were less frequently isolated, each accounting for 2.4% (n=1) of cases. No microbial growth was observed in 14.6% (n=6) of culture samples. Overall, gram-negative bacteria, particularly Escherichia coli and Klebsiella spp., were the predominant pathogens responsible for surgical site infections in the study population.

Table 6: Microbial Profile of Surgical Site Infection Cases (n = 41)

Organism Isolated	Number	Percentage
Escherichia coli	14	34.10%
Klebsiella spp.	6	14.60%
Pseudomonas spp.	4	9.80%
Proteus spp.	3	7.30%
Acinetobacter spp.	2	4.90%
Enterococcus spp.	2	4.90%
Staphylococcus aureus	2	4.90%
MRSA	1	2.40%
Streptococcus spp.	1	2.40%
No Growth	6	14.60%
Total	41	100%

Table 7 demonstrates the correlation between the types of surgical site infections (SSI) and the organisms isolated from infected cases. Among the 41 culture samples analyzed, superficial SSI was the most common type (n=27), followed by deep SSI (n=11) and organ/space SSI (n=3). Escherichia coli was the predominant organism isolated overall, identified in 14 cases, including 5 superficial SSI cases, 6 deep SSI cases, and all 3 organ/space SSI cases. Klebsiella spp. was the second most common isolate, detected in 6 cases, primarily associated with superficial SSI. Pseudomonas spp. and Proteus spp. were isolated in 4 and 3 cases, respectively, while Acinetobacter spp., Enterococcus spp., and Staphylococcus aureus were each identified in smaller numbers. MRSA and Streptococcus spp. were isolated in only 1 case each. No microbial growth was observed in 7 cases, predominantly among superficial SSI. These findings indicate that gram-negative organisms, particularly Escherichia coli, were the major pathogens associated with postoperative surgical site infections, especially in deeper and organ/space infections.

Table 7: Correlation Between Types of SSI and Organisms Isolated

Organism	Superficial SSI (n=27)	Deep SSI (n=11)	Organ/Space SSI (n=3)	Total
Escherichia coli	5	6	3	14
Klebsiella spp.	5	1	0	6
Pseudomonas spp.	3	1	0	4
Proteus spp.	2	1	0	3
Acinetobacter spp.	1	1	0	2
Enterococcus spp.	1	1	0	2
Staphylococcus aureus	2	0	0	2
MRSA	1	0	0	1
Streptococcus spp.	1	0	0	1
No Growth	6	1	0	7
Total	27	11	3	41

Table 8 depicts the antibiotic sensitivity pattern of the common microbial isolates identified among the 41 infected cases. Piperacillin-tazobactam showed the highest sensitivity, with 75.6% (n=31) of isolates being sensitive, followed by meropenem at 70.7% (n=29). Moderate sensitivity was observed for levofloxacin and amikacin, with sensitivity rates of 58.5% (n=24) and 51.2% (n=21), respectively. In contrast, ceftriaxone and imipenem demonstrated high resistance rates, with 63.4% (n=26) and 70.7% (n=29) of isolates resistant, respectively. These findings suggest that piperacillin-tazobactam and meropenem were the most effective antibiotics against the isolated organisms, whereas considerable resistance was noted against ceftriaxone and imipenem, highlighting the importance of culture-guided antibiotic therapy in surgical site infections.

Table 8: Antibiotic Sensitivity Pattern of Common Isolates (n = 41)

Antibiotic	Sensitive n (%)	Resistant n (%)
Piperacillin-Tazobactam	31 (75.6%)	10 (24.4%)
Meropenem	29 (70.7%)	12 (29.3%)
Levofloxacin	24 (58.5%)	17 (41.5%)
Ceftriaxone	15 (36.6%)	26 (63.4%)
Imipenem	12 (29.3%)	29 (70.7%)
Amikacin	21 (51.2%)	20 (48.8%)

Discussion

The present prospective study demonstrated an overall SSI incidence of 17.3% following emergency laparotomy, which is comparable to the findings of several Indian and international studies conducted in similar surgical settings. There was considerable variation in SSI rates reported by Mahesh et al., (2010) [11] in Indian tertiary hospitals ranging as wide as 6.09% to 38.7% due to the differences in operative contamination, patient characteristics and perioperative practices. Likewise, the incidence of SSI in abdominal surgeries is around 17% in another Iranian teaching hospital observed by Razavi et al., (2005) [12]. This higher rate of occurrence in emergency laparotomy patients could be explained by the fact that they are late presenters, they have a contaminated abdominal disease, the operating procedures are emergencies, and the patients were poorly optimized physiologically prior to laparotomy. Superficial SSI represented the most common infection type in this study (11.4%), while the deep incisional and organ-space infections were less prevalent, suggesting that most infections did not become deep-intra-abdominal infections. Kamat et al. (2008) [13] have reported similar superficial SSI in previous studies of abdominal surgery."

In the present study, postoperative SSI was found to be statistically significantly associated with age, with patients over 60 years of age having relatively more infections. The results are in line with the observations of Cruse and Foord (1980) [14] who found in their larger prospective study of more than 62,000 wounds that the incidence of wound infection increased with ageing. Older people may have decreased immunological function, poor blood flow to their tissues, and various other medical conditions that can hinder the healing of wounds. Mead and colleagues also found that patients over 65 years of age had more postoperative wound infections than did younger adults, which is consistent with the present finding. In the current study, infected patients were mostly male, but sex distribution was not associated statistically. This was also found by Ziv et al. [15] who proposed that hormonal and immunological factors are involved in the comparatively lower susceptibility to infection among females. More men may predispose themselves to postoperative infectious complications by smoking more and drinking more alcohol.

Patients who used tobacco, were anemic or obese, or had hypoproteinemia were found to have significant associations with the development of SSI among the patient-related risk factors assessed. The present study showed that the patients who smoked tobacco had a significantly higher incidence of postoperative infections probably because of the effects of nicotine on tissue oxygenation and the collagen synthesis process. A similar study conducted by Mahesh et al., 2010 [11] also showed higher rates of SSI among smokers and users of tobacco. In the present study, other factors significantly associated with SSI were anemia with hemoglobin less than 10 g/dL. It decreases oxygen supply to healing tissues, which decreases neutrophils activity and collagen deposition, making it more susceptible to infection. The same finding of anemia being an important predictor of postoperative wound infection was confirmed by Razavi et al. (2005) [12]. BMI (BMI>25kg/m²) was significantly associated with SSI occurrence in this study. Platell et al. (1999) [10] also found that body mass index is a significant factor in the wound infection after colorectal surgery due to the poor vascularity of the adipose tissue and greater technical difficulty in the surgery. In the current series, hypoproteinemia was the most significant factor associated with SSI, highlighting the role of a patient's nutritional condition for wound healing after surgery. Hypoproteinemia will increase the number of postoperative infectious complications by affecting the proliferation, biosynthesis of collagen, and immune function of fibroblasts. Diabetes mellitus and hypertension were also more prevalent in patients infected, but without statistical significance and may be due to the relatively low numbers of patients with these comorbidities.

Operative factors were also important in the occurrence of SSI. Infections were significantly higher in the procedures that took over two hours in the current study. In an earlier study, Kamat et al. 2008 [13] showed that long surgery leads to exposure to bacteria, contamination and tissue handling and increases the risk of SSI. Another key factor revealed in this study was the increased blood loss during surgery. Blood loss indicates the difficulty of surgery and may lead to hypoxia and immunodepression. The postoperative infection rates were significantly related to the placement of the drains, especially the intra-abdominal drains. Kamat et al. 2008 found that patients who had postoperative drainage were several times more likely to develop an SSI than patients who did not have postoperative drainage [13]. Trapped drains can become foreign bodies that allow bacteria to enter the operative field, particularly if the drains remain for longer periods.

In the present study, the majority of surgical diagnoses and proportion of SSI cases were related to perforation peritonitis. The same has been noted in articles related to abdominal surgery, where peritonitis is known as one of the most important factors affecting postoperative infection due to the presence of a large number of particles in the abdomen and the septic physiological status of the abdomen (Razavi et al., 2005) [12]. Secondly, acute appendicitis presented with the highest rate of SSI in this study, and the incidence of SSI was lower in cases of cholecystitis, intestinal obstruction and volvulus. An open surgery for emergency surgery and bowel spillage will always increase the risk of postoperative wound infection.

In the present study, microbiological analysis showed a higher prevalence of gram-negative enteric bacteria, where Escherichia coli was the most prevalent gram-negative (34.1%) followed by Klebsiella spp. and Pseudomonas spp. These results are very similar to that of Kamat et al., 2008 [13] who also found gram-negative bacilli to be predominant in abdominal SSIs. Also, Mofikoya et al. (2011) [16] isolated Pseudomonas and Escherichia coli as common pathogens in abdominal wounds. The high number of enteric organisms is indicative of contamination from gastrointestinal flora with procedures carried out during emergencies on the abdomen. However, Akinkunmi et al., 2014 [17] reported Staphylococcus aureus as the most predominant pathogenic microorganism in Nigerian surgical wound which shows regional variation of the microbial ecology and pattern of hospital infection. In the present study, it has been observed that gram negative enteric bacteria, particularly Escherichia coli, were the most common organisms involved in deep and organ space infections highlighting the need of intra-abdominal contamination in the most serious forms of SSI.

Antibiotic sensitivity analysis showed that the most sensitive organism was Piperacillin-Tazobactam and Meropenem showed considerable resistance. The same pattern of resistance has been more commonly reported in developing countries where application of antibiotics is irrational, and empirical treatment has become common. Surgical isolates were reported to be highly resistant to β-lactam antibiotic use as reported by Akinkunmi et al. 2014 [17]. The present results show an alarming increase in the level of antimicrobial resistance of gram-negative pathogens responsible for postoperative wound infections. Therefore, culture-directed therapy and tight antimicrobial stewardship are critical to enhance healing from surgery and decrease the impact of MDR-HAI. The overall findings of the present study confirm the multifactorial nature of SSIs after emergency laparotomy, and emphasize the need of optimizing the patient preoperatively, ensuring meticulous operative technique, infection control measures and judicious use of antibiotics to reduce the postoperative morbidity.

Conclusion

The present prospective study shows that surgical site infection continues to be one of the major complications after emergency laparotomy in west Bengal and is a major cause of morbidity in patients. The most frequently reported SSIs were superficial infections, of which gram-negative organisms were the most common (Escherichia coli was the most common). Advanced age, tobacco usage, anemia, obesity, hypoproteinemia, longer operative time, greater blood loss and placement of a drain were factors significantly associated with SSI. Also, the findings showed different antimicrobial sensitivity patterns, which highlights the necessity to use suitable antibiotic and infection control measures. In emergency laparotomy patients, early recognition of high-risk patients, nutritional optimization, meticulous surgical techniques and following strict aseptic precautions could be beneficial in minimizing the postoperative infection and enhancing the overall surgical success.

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